Shore-Based Shipping Costs of Containerised Cargo: A 1991 Update

Information Paper

This study updates to 1991, the components of shore based shipping costs included in the Industry Task Force 1986 Shore-Based Shipping Final Report, and BTE Occasional Paper 80, Shore-based Shipping Costs, Non-bulk Cargo. Estimates are presented for the total costs of moving containerised cargo between ships and warehouse.The potential impact on costs of more even cargo flows is examined.

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SHORE BASED SHIPPING COSTS OF CONTAINERISED CARGO

A 1991 UPDATE

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FOREWORD

The Bureau was commissioned in 1991 by the House of Representatives Standing Committee on Transport, Communications and Infrastructure, chaired by The Hon Peter Morris MHR, to provide an analysis of shore based shipping costs for the Inquiry into the Efficiency of the Interface between Seaports and Land Transport. That work resulted in two submissions to the Inquiry: Submission 85, 'Shore Based Shipping Costs, a 1991 Update' and Submission 86 'The Costs of Uneven Flows of Containers Through Container Terminals'. This report reproduces the material in those submissions.

The analysis was conducted by Neil Gentle and Anthony Carlson. The Bureau wishes to acknowledge the invaluable assistance provided by the container terminal operators in Sydney and Brisbane, and various other port and transport operators.

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April 1992

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ABSTRACT

This study updates to 1991, the components of shore based shipping costs included in the Industry Task Force 1986 Shore-Based Shipping Final Report, and BTE Occasional Paper 80, Shore-based Shipping Costs, Non-bulk Cargo. Estimates are presented for the total costs of moving containerised cargo between ships and warehouse. The potential impact on costs of more even cargo flows is examined.

The analysis suggests that by late 1991 shore based shipping costs declined in real terms by 13 to 22 per cent for FCL containers and by 14 to 18 per cent for LCL containers, compared with those estimated for 1984–85. Overall, for containers moving through mainland capital city container terminals this represents a cost savings, in real terms, of $214 million or 17 per cent. These reductions reflect both the impact of economic recession on margins and the initial effects of micro-economic reform in container terminals and other port activities.

The total potential savings from establishing a more even flow of containers, were estimated at approximately $10 million during 1991. This potential saving is relatively small compared with total shore based shipping costs. Truck queues have, in the past, been associated with uneven cargo flows, but by late 1991 these queues had already been substantially reduced.

These potential savings would at first accrue to terminal operators (terminal equipment savings) and ship operators (ship delay savings). Ultimately it could be expected that both groups would pass the savings on to their customers. Eventually importers and exporters would benefit.

CHAPTER 1 INTRODUCTION

Shore based shipping costs for 1983–84 were estimated by the then Bureau of Transport Economics (BTE) for the Webber inquiry (Webber 1986). These estimates updated to 1984–85 were also published by the BTE in Occasional Paper 80 (BTE 1986). Since then the micro-economic reform process has been established, although it has yet to take its full effect in the waterfront industry. The reforms implemented so far are expected to improve productivity and to reduce costs in port authorities, and in the stevedoring and towage industries.

The interface between the waterfront and land transport has not been subject to the same level of scrutiny as the stevedoring industry, but nonetheless has been the cause of excess costs to importers and exporters. The improvements that have occurred within the ports serve to highlight the need to extend the reform process to the interface with land transport.

This paper presents the results of a study updating earlier estimates of shore based shipping costs. As with the Webber report and Occasional Paper 80 the analysis incorporates port and related charges, stevedoring, land transport and packing and unpacking costs. The analysis therefore allows changes in the structure of shore based shipping costs to be identified.

The analysis was also extended to include an examination of the effects of an uneven flow of containers through terminals.

SHORE BASED SHIPPING COSTS

The estimates of shore based shipping costs in the paper are based on prices current during late 1991. The estimates therefore include the influence that Enterprise Based Agreements (EBAs), implemented during 1991, may have had on prices.

Improved terminal productivity resulting from the EBAs will also be reflected in lower costs elsewhere in the transport chain. For example, some newspaper reports have suggested that there have already been major reductions in truck queue severity. Lower road transport costs can be expected as these improvements work through the market. However, information collected by the Bureau of Transport and Communication Economics (BTCE) showed no indication that this had yet occurred. Similarly ship turn-around times are

expected to improve. Eventually sea freight rates should reflect reduced ship and port costs and the improved ability of ship operators to maintain published schedules.

There are two factors which lessen the effectiveness of the comparison of the results of the present study with the earlier analyses. The first is that unlike the period of the earlier analyses, the current period is characterised by recession. This means that charges would tend to be lower even in the absence of reform. Therefore price reductions identified in the analysis may tend to overstate the effect of recent changes in the industry.

The second factor is that the analysis focuses on the estimation of indicative prices. This was the approach adopted in the earlier studies. Some shore based shipping services are reasonably homogeneous so that an indicative price is close to that paid by most consumers. Other services can vary considerably in the degree of complexity involved and hence in the prices charged. For these services the choice of an indicative price from within the wide range of prices experienced in the industry is somewhat arbitrary so that comparison between a price chosen from a wide range of 1985 prices and a wide range of 1991 prices may not give an accurate estimation of the trend over this time period. Estimates falling into this category are given suitable qualifications in the paper.

Data were obtained principally from industry sources, such as, port authorities, terminal operators, towage firms, road transport associations, and from published information where this was available. Costs are estimated on the basis of costs per loaded TEU (Twenty-foot equivalent unit). Some charges are levied on empty TEUs (eg wharfage charges by port authorities). It was assumed that these would be treated as an overhead and factored into the prices charged to importers and exporters.

UNEVEN CONTAINER FLOWS

The flow of containers through a container terminal is affected by a number of factors which are not always directly under the control of terminal management. This uneven flow can impose costs on terminal operators and ultimately on importers and exporters. This paper examines these factors and makes some broad assessment of their likely effect and costs.

The analysis refers to conditions applicable to 1991, a period of recession in the Australian economy. Trade volumes were generally low. In addition, the implementation of EBAs at some terminals had improved productivity substantially by late 1991. The combination of these two factors created excess capacity in the major terminals. This excess capacity allows terminals to handle peaks in container flows with no significant degradation in performance. Therefore casual observation of the terminals might suggest that an uneven flow of containers is not presently a problem. One terminal operator commented to Bureau officers that his terminal staff 'could now handle anything that was thrown at them'.

However, as economic recovery develops and trade volumes grow and as excess equipment is not replaced at the end of its economic life, the effect of uneven flows will become more apparent.

Bureau staff visited four container terminals in Sydney and Brisbane and analysed data provided to the House of Representatives Standing Committee on Transport, Communications and Infrastructures (HORSCOTCI) Interface Inquiry. The terminal visits were used to gather data on terminal operations and to gain an understanding of how uneven flows might affect costs. The Bureau expresses its appreciation for the assistance provided by the management of these terminals.

CHAPTER 2 WEBBER REPORT AND OCCASIONAL PAPER 80 ESTIMATES

Table 2.1 reproduces the estimates of shore based shipping costs contained in the Webber report (1986). These estimates were produced by the then BTE.

These figures were subsequently updated by the BTE and published in Occasional Paper 80 (BTE 1986). The updated estimates of port and related charges were $20 higher than those estimated for 1983–84. Occasional Paper 80 also contained a disaggregation of port and related charges. This disaggregation is shown in table 2.2.

The Webber report provided the following definitions of the cost items:

Port and related charges
These include wharfage, gangway watchmen, berthing lines, tugs, sea pilotage, harbour light dues, Commonwealth navigation charges.

Stevedoring
This is a typical charge made to shipping companies for the services provided by container terminals which include the activities of the land interface as well as ship side operations.

No allowance was made for refrigerated containers or other special requirements.

Import/Export Documentation
This is based on typical customs agents charges. LCL (less than container load) containers carry on average between four and five individual consignments, each of which involves documentation and clearance costs.

Transport to/from the wharf
This was based on a survey of several road transport companies and was an average for FCL (full container load) containers delivered to, or picked up from, the urban or metropolitan area of the port. It includes a demurrage component of up to $50 for queuing at terminal gates.

The LCL cost covers the movement between terminal and depot only.

TABLE 2.1 INDICATIVE SHORE BASED SHIPPING COSTS FOR CONTAINERISED CARGO, 1983–84 CONTAINED IN THE WEBBER REPORT
($ per TEU)

	Imports		*Exports*	
Cost category	*FCL*	*LCL*	*FCL*	*LCL*
Port and related charges	160	160	100	100
Stevedoring	230	230	230	230
Import/export documentation	80	300	40	220
Transport to/from wharf	120	60	120	60
Packing/unpacking	150	600	150	600
Transport to/from depot	..	390	..	390
Total	740	1740	640	1600

.. Not applicable.

Source Webber (1986).

TABLE 2.2 INDICATIVE PORT AND RELATED CHARGES FOR NON-BULK IMPORTS AND EXPORTS[a], 1984–85
($ per TEU)

Cost category	*Imports*	*Exports*
Department of Transport navigation charge[b]	6	6
Pilotage	13	13
Harbour and light[c]	5	5
Tonnage	6	6
Tugs	22	22
Berthing lines[d]	4	4
Gangway watch	4	4
Water and electricity	1	1
Wharfage	89	57
Overtime storage	26	..
Total	176	118

a. This table assumes 25 000 GRT vessel with an average time at berth of 36 hours, interchanging 516 containers of which 280 are imports (discharged), 132 are exports (loaded) and 104 are empties (in or out). These estimates were derived from overseas container throughput and container vessel calls to Sydney and Melbourne during 1983–4 and 1984–85.

b. This assumes 1.25 vessel calls per 3 months

c. This assumes 2.5 vessel calls per 6 months.

d. Includes line launch.

.. Not applicable.

Source BTE (1986)

Packing/unpacking
This was based on a survey of international depots. The cost of packing/unpacking FCL containers at an exporter's/importer's premises is considerably less.

Transport to/from depot
This cost was derived from a survey of road transport companies. The cost refers to the delivery or pick up of individual consignments within the urban or metropolitan area of the port.

CHAPTER 3 BTCE 1991 ESTIMATES

The estimates in this present study were based on the same assumptions as were used in the earlier studies wherever possible. This is to allow valid comparisons of charges over the time period in question. Data were collected only for Sydney and Melbourne. These two ports together account for approximately 80 per cent of Australia's container trade. Therefore the shore based shipping costs estimated on the basis of data collected from these ports represents a significant proportion of the Australian total.

The following sections outline the assumptions and the approach taken in each of the cost estimates.

PORT AND RELATED CHARGES

Ship based charges

Occasional Paper 80 and the Webber report gave the costs in terms of dollars per TEU. The charges discussed so far are ship based charges. Conversion of these to dollars per TEU requires information on the numbers of TEUs exchanged per ship call. These data were obtained from the Waterfront Industry Reform Authority (WIRA) performance indicators. These indicators also allowed estimation of the average time each ship was at the berth so that the Port of Melbourne Authority (PMA) berth hire charges could be calculated.

The WIRA throughput figures include empty containers. Ship based charges and port authority wharfage charges were allocated to loaded containers. Data on the proportion on empty containers in each port's throughput was derived from data in the Container International Yearbook for 1990 (Containerisation International 1990) and from PMA statistics (PMA 1990).

The port performance data used in calculating port and related charges are shown in table 3.1.

Port charges were estimated for a 25 000 GRT (gross registered tonne) cellular container ship using Botany Bay and Melbourne. This ship type and size are the same as that chosen for the 1984–85 study discussed above.

TABLE 3.1 PORT STATISTICS USED IN ESTIMATING PORT AND RELATED CHARGES

	Sydney	*Melbourne*
Ship size (GRT)	25 000	25 000
Ships handled	448	523
TEUs	243 319	312 574
Percentage empty	16.97	18.26
Handling rate (percentage berth hour)	13.98	17.59
TEUs/ship	543	598
Av berth time (hours)	38.8	34.0
Berthing delay (hours)	6.4	3.1
Port time (hours)	45.2	37.1

Source WIRA (1991).

As for the earlier analysis fair weather was assumed. Port charges used were those published by the Maritime Services Board (MSB) and the PMA and which were current in June 1991. In each port it was assumed that ships on average made five calls per year. This assumption is relevant for the estimation of Commonwealth charges and for some State Government charges.

The MSB charges include pilotage but do not include mooring/unmooring or towage. These services are provided by the private sector. Howard Smith were contacted to obtain information on towage charges and Marine Plant Holdings were contacted about mooring/unmooring charges. Towage charges were based on two 'A' grade tugs in each direction.

The PMA charges unlike the MSB charges do not include pilotage which is provided by a private company (Port Phillip Pilotage Service). This company provided current charges to the Bureau.

Melbourne towage charges were also provided by Howard Smith. As for Sydney the charges were based on the use of two tugs in each direction.

The PMA provides mooring/unmooring services. Average charges for the assumed 25 000 GRT ship were provided by the PMA.

Cargo based charges

Wharfage charges

In addition to wharfage charges for loaded TEUs, port authorities also levy a wharfage charge on empty containers. It is assumed that in the normal course of business ship operators would recover these charges from importers and exporters through freight rates. Wharfage charges for loaded TEUs published by the port authorities were therefore increased to cover the wharfage charges for empty TEUs.

Overtime storage charges

Terminal storage for import containers is usually free for the first three days after the departure of the ship. Storage charges after that time are typically $20 per day per TEU for the next three days, $40 per day for the following three days and $80 per day thereafter. There is some variation in charges between terminals. Containers may be placed into bond store if not collected within a reasonable period of time.

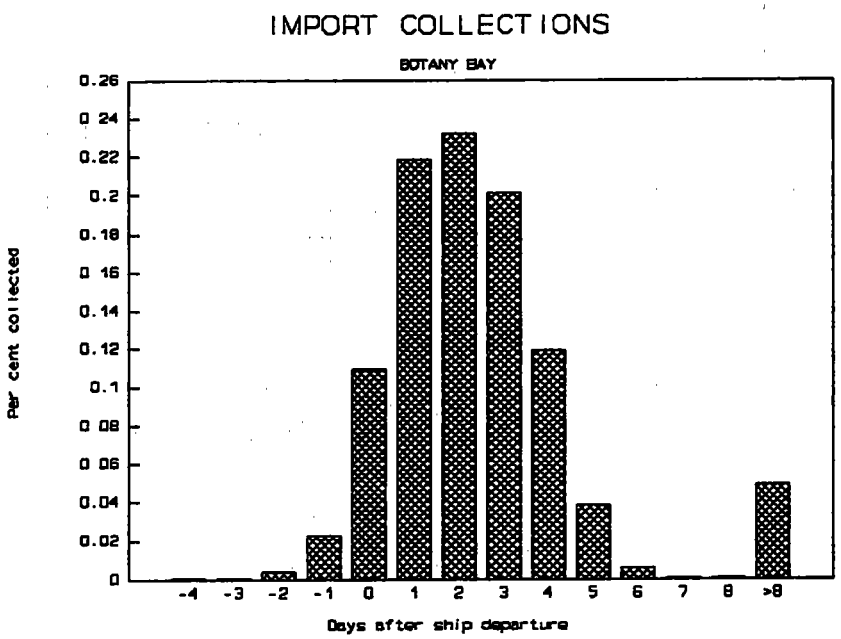
Distributions of dwell times for import containers discharged in Sydney and Melbourne were derived from data supplied to the Interface Inquiry. These distributions are shown in figure 3.1. The sample sizes were approximately 30 000 containers for Sydney and 10 000 for Melbourne. The figure illustrates the number of business days after ship departure as this is the usual basis for determining the free storage period.

The distributions in figure 3.1 were used in conjunction with storage charges provided by industry sources to estimate an overtime storage charge averaged over all import containers. Containers remaining uncollected nine days after the departure of the ship were assumed to be bonded at a charge of $90. Using these assumptions the storage charge averaged over all import containers estimated was $22.50 per TEU for Sydney and $8.90 per TEU for Melbourne.

Inventory costs during overtime storage

The earlier analysis allowed for inventory costs during overtime storage as part of the costs incurred during this period. Current interest rates are around 10 per cent which is less than the 15 per cent assumed in Occasional Paper 80. Unit value per tonne for imports carried by conference liners in the second half of 1990 was around $4200 per tonne. There are approximately 11 tonnes per import TEU, which gives $46 200 per TEU (BTCE 1988). The values reported by the Australian Bureau Statistics in the Shipping and Air Cargo Commodity Statistics data are f.o.b. values. An additional $4000 is a reasonable amount to add to the f.o.b. value per TEU to convert it to a c.i.f. value, which is the value relevant to the importer, giving a value of approximately $50 000 per TEU. The interest charges per loaded TEU can be then calculated as $13.70 per day.

Using this value of inventory cost and the distributions of dwell times gives an inventory cost of $10.50 per import TEU for Sydney and $3.60 for Melbourne.



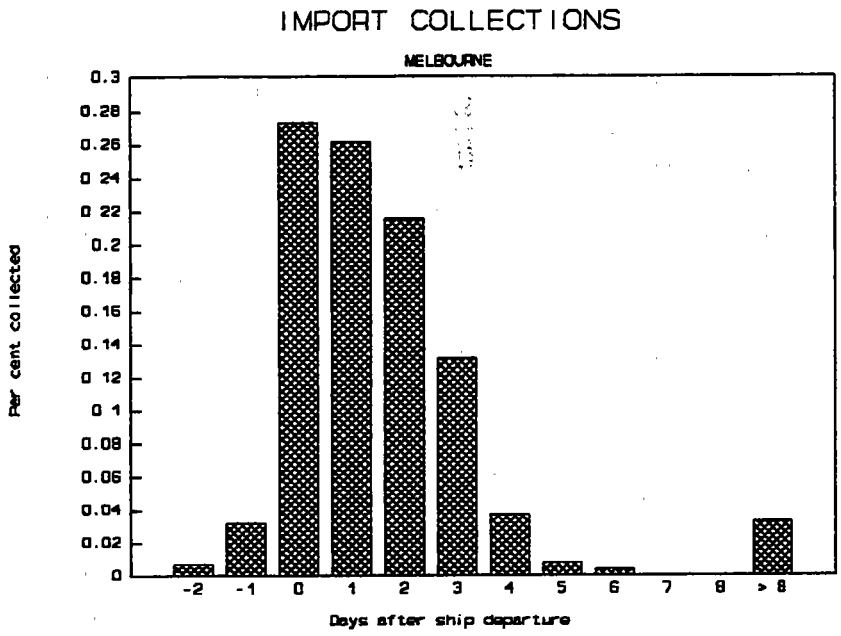


Figure III.1 Import collection distributions

Source Data supplied to HORSCOTCI.

The total cost of overtime storage to the importer is therefore $8.90 plus $3.60 or $12.50 for Melbourne and $22.50 plus $10.50 or $33.00 for Sydney.

RESULTS OF PORT AND RELATED CHARGES ANALYSIS

Table 3.2 displays the results of the estimates of 1991 port and related charges and table 3.3 compares 1985 charges with 1991 charges.

The most obvious feature of this table is the substantial difference in the evolution of charges between imports and exports. There are two reasons for this. The first is the effect of shifting the burden of charges from cargo based to ship based in both Sydney and Melbourne. The result of this has been to reduce the influence of wharfage charges on the overall charge per TEU. In the 1985 analysis, differences in wharfage charges were the major source of differences in the total charges for exports and imports. Reducing the relative size of wharfage charges has reduced the potential for discrimination between import and export cargoes.

The second reason is that the PMA has, in its port pricing reform, eliminated discrimination between imports and exports entirely in its wharfage charges.

It is also interesting to note that although Melbourne and Sydney have taken different approaches to port pricing reform their charges per TEU differ only slightly for exports. The higher wharfage charges in Sydney almost totally offset the higher ship charges in Melbourne. For import containers, the difference in wharfage charges between Sydney and Melbourne is much larger and is only partially offset by the higher Melbourne ship charges.

Stevedoring

Estimated stevedoring charges published by the Prices Surveillance Authority (PSA) for 1990 (PSA 1990) provided a starting point for estimating 1991 prices. Terminal operators were consulted on the movement of charges since the publication of the PSA estimates. There was general consensus that prices had declined by up to 25 to 30 per cent by late 1991 as a consequence of the recession and higher productivity following implementation of the EBAs. Information from other sources confirmed that reductions of this order of magnitude were common. Prices of $220 per TEU for Sydney and $200 for Melbourne were thought to be typical of stevedoring charges in late 1991.

Customs entries

Estimates for this cost category were derived from information supplied by Customs Agents Associations in NSW and Victoria.

Customs agents charges depend on the complexity involved in the clearance process. Because there is a wide range in the complexity there is a corresponding wide range in the charges per TEU experienced in practice. The charges selected for inclusion in the analysis are those suggested by industry sources as being indicative of the charges likely to be charged per TEU for a clearance of an

TABLE 3.2 PORT AND RELATED CHARGES 1991 CALENDER YEAR
(dollars)

	Sydney		*Melbourne*		*Average*[a]
	per ship	*per TEU*	*per ship*	*per TEU*	*per TEU*
Ship based charges					
Berth hire			7 645	15.65	8.80
Navigation charge	12 500	27.72	5 150	10.54	18.06
Tonnage			14 000	28.66	16.11
Mooring/unmooring	2 476	5.49	2 500	5.12	5.28
Pilotage	54 20	12.02	3 337	6.83	9.10
Towage	9 772	21.67	10 000	20.47	20.99
Marine Navigation Levy	6 760	14.99	6 760	13.84	14.34
Oil Pollution Levy	264	0.59	264	0.54	0.56
Electricity and water		1.00		1.00	1.00
Sub-total	37 192	83.47	49 656	102.64	94.25
Cargo based charges					
Wharfage[b]					
import		108.34		55.35	78.54
export		72.34		55.35	62.79
Overtime storage		33.00		12.50	21.47
Total					
import		224.81		170.50	194.27
export		155.81		158.00	157.04

a. Weighted average with number of TEUs handled as the weights.

b. Adjusted for empty containers.

Source BTCE estimates based on port authority price schedules and other industry sources (see text).

average level of complexity. However, these are indicative charges only and individual importers and exporters may be charged amounts which differ substantially from these values.

The Webber report assumed that there were between four and five consignments per LCL container. To be consistent, in this analysis it was assumed that there were 4.5 consignments per LCL container in 1991. It was not possible in the time available to check if this assumption was reasonable. However one customs agent advised the Bureau that in his opinion it was likely that if there were any

TABLE 3.3 COMPARISON OF 1985 PORT AND RELATED CHARGES WITH 1991 CHARGES

Trade direction	1985 prices[a] ($)	1991 prices ($)	Ratio of 1991 to 1985 prices (per cent)
Import	260	194	74.8
Export	174	158	90.2

a. Expressed in 1991 dollars using GDP deflator.

Source Table 3.2 and Webber (1985)

change it would be an increase in the number per TEU. The reason for this is that in the current economic environment many importers are attempting to keep their inventories at as low a level as possible. This implies that they tend to make more frequent but smaller orders.

TRANSPORT TO/FROM THE WHARF AND TO/FROM THE DEPOT

FCL containers

The carriage of containers between the wharf and a customer's warehouse is charged at a rate which depends on the distance and the weight of the container. Different rates are charged for 20 foot and 40 foot containers.

It was assumed that containers were transported 10 kilometres to or from the wharf. The Bureau previously estimated that containers have a load of 11.5 tonnes per TEU for imports and 14.6 tonnes for export TEUs (BTCE 1988). Not a large amount of data are readily available on the proportion of 40 foot containers used in Australia's trade. Information published by the PMA (1990) indicated that 40 foot containers comprised 22.2 per cent of import TEUs and 11.3 per cent of export TEUs through the port of Melbourne. These proportions were also used for Sydney.

Rates for the carriage of containers were obtained from road transport associations and customs agents and these rates were used with the above estimates to compute the indicative charges. The published rates of road transport companies usually include an allowance for delays at the terminal, time waiting at the customer's warehouse for the container to be unpacked and the return of the empty container.

LCL containers

The carriage of containers between the wharf and a container depot generally costs less than the transport of containers between the wharf and a customer's warehouse. Depots are often located close to the waterfront and some are

located at the terminal itself. As with the 1985 analysis, the transport costs between the wharf and the depot were estimated to be one half of the cost of transport between the wharf and the importer's or exporter's premises.

Transport of consignments between the depot and the importer's or exporter's premises is performed in trucks much smaller than those involved in the movement of containers. The rate charged is usually based on the volume or mass of the consignment. Published rates for consignments with a volume of between five and six cubic metres were used for estimating this charge.

PACKING AND UNPACKING CHARGES

Depot charges

Charges at container depots are those estimated by the PSA (1990). The PSA gave a range of values form $600 to $650. The upper limit was used in this analysis. This allowed for any increase in charges since the PSA made its estimate. The upper limit is also consistent with the approach taken in the Webber report and Occasional Paper 80.

Unpacking of FCLs at warehouses

Some road transport operators offer a container packing and unpacking service to their customers. The rate charged depends on whether the cargo is packed on pallets or loose stowed. The rate for the former is lower than that charged for the latter. An average of the two rates was chosen as an indicative rate.

CHAPTER 4 TRENDS IN SHORE BASED SHIPPING COSTS

COSTS PER TEU

The estimated costs per TEU are shown in table 4.1 for imported containers and in table 4.2 for exported containers. The tables show that there has been an overall reduction in real shore based shipping costs. Reductions in stevedoring, container depot and port and related charges are the major reason for the decline. These are the areas where the reform process has been focused.

The figures suggest that customs clearance charges have increased in real terms. However, caution is needed in the interpretation of these figures. As mentioned earlier there is a wide range in the prices charged for customs clearance, principally because of the diversity in effort required for individual clearances. The choice of an indicative price tends to be arbitrary so that indicative prices selected from two time periods may not accurately reflect the underlying trends.

The costs displayed in tables 4.1 and 4.2 are for non-refrigerated containers. Refrigerated containers are estimated to cost an additional $100 to $150 more (PSA 1990). In 1985 the additional costs were estimated to be $190 (BTE 1986).

Although some qualifications are required, the results suggest that, depending on port and direction of trade, there has been a real reduction in shore based shipping costs of 13 to 22 per cent per FCL container and 14 to 18 per cent per LCL container.

AGGREGATE COSTS

Aggregate costs were estimated for containers handled by container terminals. The number of containers handled by container terminals in the five mainland capital city ports is reported by WIRA in its quarterly reports of performance indicators. These reports do not disaggregate the movements into empty and loaded containers or distinguish between import and export containers. Data in the Containerisation International Yearbook for 1990 were used to estimate the number of empty containers and the split between imports and exports. The number of refrigerated containers in 1990–91 was derived from data in BTCE (1989) which contained estimates of the number of refrigerated containers through the five major ports in 1987 and the Containerisation International Yearbook which contained throughput data for the same year. The ratio of

refrigerated containers to loaded containers in 1990–91 was assumed to be the same as that in 1987.

Using these assumptions the total shore based shipping costs of handling containers through container terminals in the five mainland capital city ports in 1990–91 was estimated to be $1030 million. If the costs per TEU had remained at 1985 levels in real terms the costs would have been $1244 million. The reduction in real terms is $214 million or approximately 17 per cent. The extrapolation from Sydney and Melbourne data to all container ports may lead to some errors. However, because of the dominant position of these ports in Australia's container trade, errors from this source are likely to be small.

TABLE 4.1 SHORE BASED SHIPPING COSTS — IMPORT CONTAINERS, 1991 CALENDAR YEAR

	Sydney		*Melbourne*		*Average*[a]		*1985 costs*[b]	
Cost category	*FCL*	*LCL*	*FCL*	*LCL*	*FCL*	*LCL*	*FCL*	*LCL*
	($/TEU)		*($/TEU)*		*($/TEU)*		*($/TEU)*	
Port and related charges	225	225	170	170	194	194	260	260
Stevedoring	220	220	200	200	209	209	339	339
Customs entries	150	585	120	540	133	560	118	443
Transport from wharf	184	92	198	99	192	96	177	89
Unpacking	178	650	178	650	178	650	221	886
Transport from depot		465		507		489		576
Total	957	2 237	866	2 166	906	2 197	1 116	2 592
Percentage of 1985 costs	86	86	78	84	81	85		

a. Weighted average with numbers of TEUs as the weights.

b. In 1991 dollars, using GDP deflator.

Note: Figures may not add to totals due to rounding errors

Source Table 3.2, PSA (1990) and industry sources (see text).

TABLE 4.2 SHORE BASED SHIPPING COSTS — EXPORT CONTAINERS, 1991 CALENDAR YEAR

Cost category	Sydney		Melbourne		Average[a]		1985 costs[b]	
	FCL	LCL	FCL	LCL	FCL	LCL	FCL	LCL
	($/ TEU)		($/TEU)		($/TEU)		($/TEU)	
Transport to depot		465		507		489		576
Packing	178	650	178	650	178	650	221	886
Transport to wharf	211	106	217	108	214	107	177	89
Customs entries	80	360	80	360	80	360	59	325
Stevedoring	220	220	200	200	209	209	339	339
Port and related charges	156	156	158	158	157	157	177	177
Total	845	1 957	833	1 983	838	1 972	974	2 391
Percentage of 1985 costs	87	82	86	83	86	82		

a. Weighted average with numbers of TEUs as the weights.

b. In 1991 prices, using GDP deflator.

Note: figures may not add to totals due to rounding errors

Source Table 3.2, PSA (1990) and industry sources (see text).

CHAPTER 5 UNEVEN CONTAINER FLOWS THROUGH TERMINALS

Unevenness in the flow of containers into and out of a terminal can occur through the following processes:

- day-to-day variation in the delivery of export containers by land transport;
- day-to-day variation in the collection of import containers by land transport;
- hour-to-hour variation in the number of truck arrivals during the hours the terminal is open for road receipts and collections; and
- random pattern of ship arrivals.

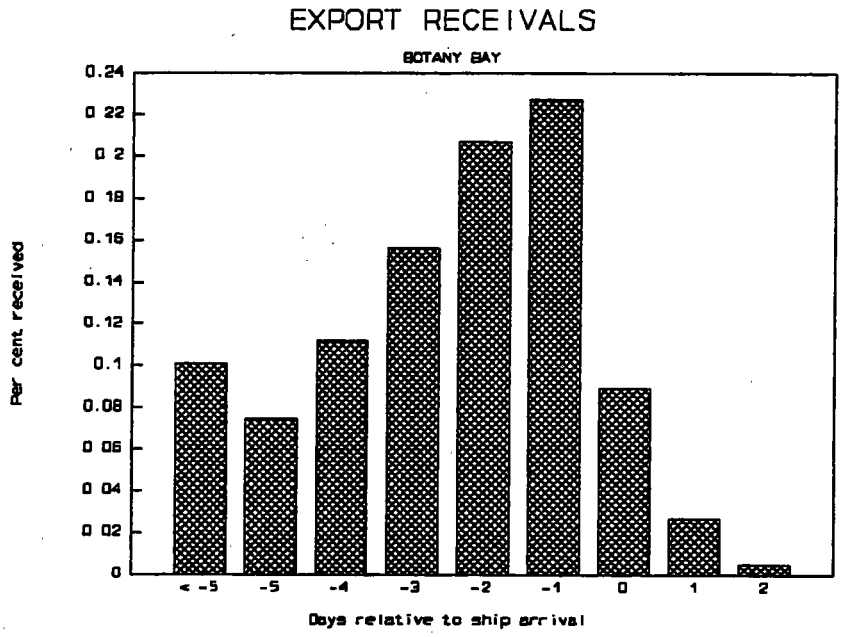
DISTRIBUTION OF EXPORT RECEIPTS

Data provided to the Inquiry included information on the distribution of export receipts and import collections at terminals in the mainland capital city ports for the first half of 1991. Data were analysed for Sydney and Melbourne. The distributions of export receipts are shown in figure V.1.

The distributions have similar shapes for the two ports with the proportion of container receipts increasing as ship arrival approaches. From an operational point of view it is the proportion of containers which arrive late which matters most. Some terminal operators plan stack layouts so that loading of the ship involves no double handling of containers. Export stacks are laid out in terms of destination port and container weight. All terminal operators plan container loading sequences to avoid double handling of containers, both during the loading process and at later ports. The loading sequence also ensures that ship stability requirements are met.

Containers which are delivered after the ship arrives necessitate the loading sequences being re-planned and may mean that additional stack space must be allocated. Containers which arrive very late may have to be stowed inefficiently on the ship. When this occurs, containers are restowed at a subsequent port. No data were available on the number of containers affected in this way.

Both Sydney and Melbourne had a similar proportion of late delivered containers for the period analysed. In both ports, the proportion was between 12 and 13 per cent or about one in eight containers.



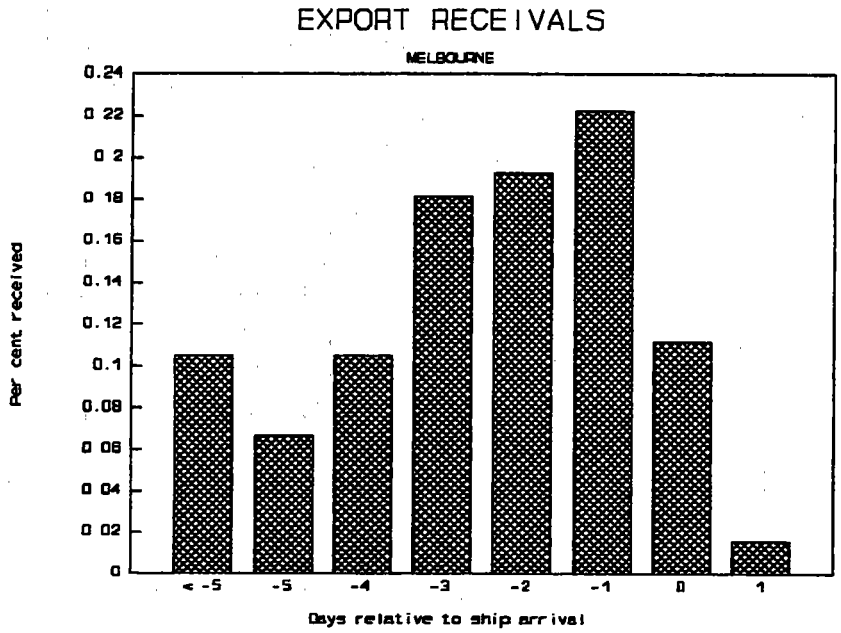


Figure V.1 Export receipt distributions

Source Data supplied to HORSCOTCI.

As stevedoring productivity improves in response to the implementation of the EBAs, ship turnaround times can be expected to improve. One terminal operator commented to the Bureau that it was now common for ships to be serviced within 24 hours. Under these circumstances there will be less opportunity for exporters to deliver their containers to the port after the ship arrives and still expect to have their containers loaded. Once improved stevedoring productivity is accepted as being a normal part of port operations it can be expected that ship operators will amend their schedules. The proportion of export containers delivered late should therefore decline.

DISTRIBUTION OF IMPORT COLLECTIONS

The distributions derived from data provided to the Inquiry are shown in figure V.2.

The distributions differ markedly between the two ports. Melbourne importers tend to collect containers earlier than their Sydney counterparts. In both ports some import containers are collected before the ship departs, this being more pronounced in Melbourne. Terminal operators expressed only minor concern about the pattern of collections and the small number remaining after the free storage period created few problems. One problem that was mentioned was that at the end of the free storage period the import stack becomes fragmented and time was usually spent during night time shifts to consolidate the remaining containers.

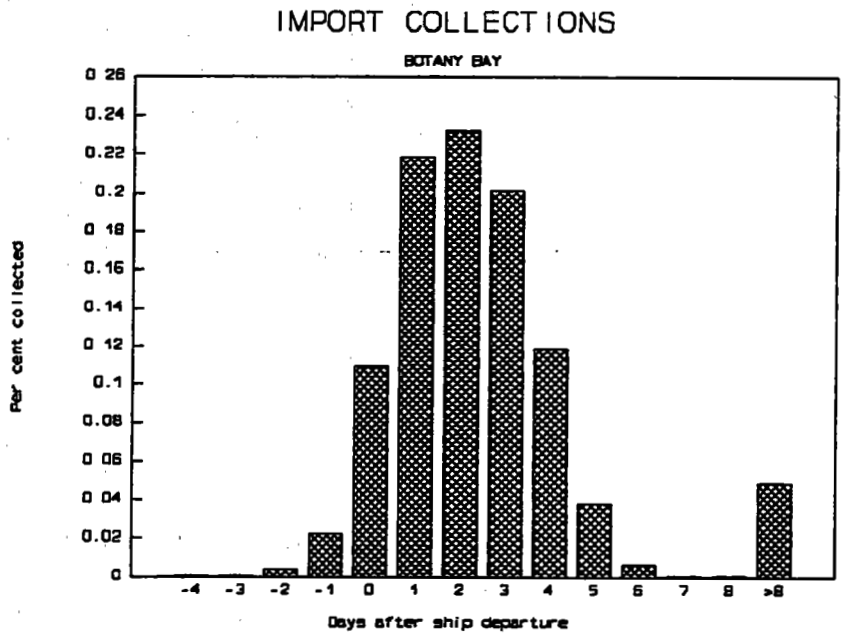
EFFECT OF EXPORT DELIVERY AND IMPORT COLLECTION DISTRIBUTIONS ON TERMINAL PERFORMANCE

The daily number of containers handled by terminals at the terminal–road interface is a result of the interaction between the import collection and export delivery distributions. In the larger ports where ship arrivals are a daily occurrence it is an easy matter to show that no matter what the distributions look like the daily number of containers handled at the road interface is reasonably uniform.

A simple example will suffice to illustrate the point. Assume that each ship loads 100 export containers and discharges 100 import containers. Also assume that the distributions are as follows:

Export receipt					
Days before arrival:	3	2	1	0	
Number received:	20	30	40	10	
Import collection					
Days after departure:	0	1	2	3	4
Number collected:	10	25	30	25	10

Now assume that each ship is in port for two days and that a new ship arrives every second day. On average there will be 100 containers per day to be handled at the road interface. With the above distributions the number handled each day



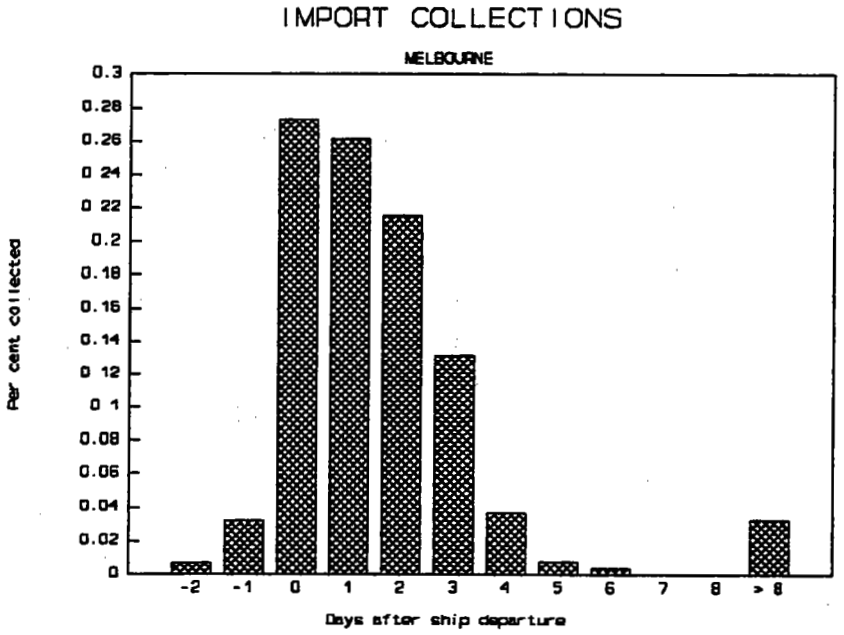


Figure V.2 Import collection distributions

Source Data supplied to HORSCOTCI.

would alternate between 110 and 90. Although the distributions are not uniform the daily number of containers handled is close to uniform.

In practice, the delivery and receipt patterns vary about the distributions shown in figures V.1 and V.2 as do the number of containers arriving or departing on each ship. Nevertheless the day-to-day variations in export delivery and import collection patterns have only a minor influence on terminal operations.

HOURLY VARIATION IN TRUCK ARRIVALS

Truck arrivals are typically most dense in the early hours of the morning and decline as the day progresses. Most terminals are able and willing to service trucks during the evening shift, but normally this shift is mostly used for bulk container movements. Figure V.3 illustrates a typical daily pattern of truck services for a Brisbane terminal. The distribution is only for the hours of the day time shift. The evening shift in this sample of processed trucks performing bulk runs, the number of which was almost equal to number of trucks processed during the day shift. The proportion of bulk runs is usually smaller in other ports. For example the Victorian Joint Industry Project (1990) looking at truck management in the port of Melbourne found that only 19 per cent of containers moved in bulk runs.

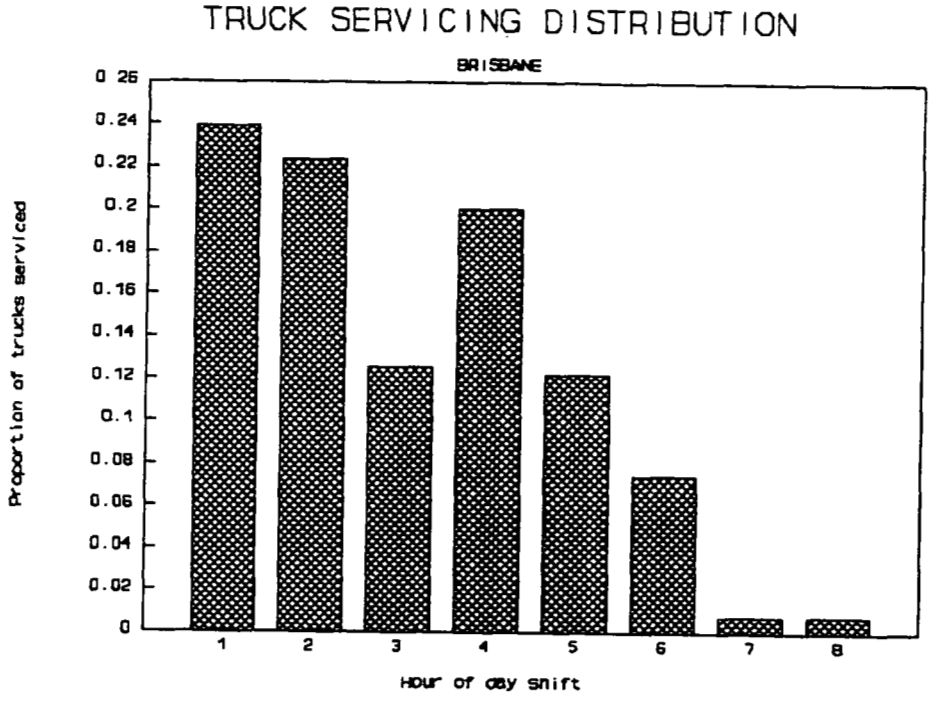


Figure V.3 Distribution of truck servicing (Brisbane)

Source Data supplied by terminal operators

The quantity of equipment allocated to road work reflects the expected pattern of truck arrivals. If the flow of trucks were uniform then fewer items of equipment would be required to service the same number of trucks. The following analysis estimates the potential equipment savings under the assumption that the number of trucks serviced per hour is uniform throughout both the day and evening shifts. The analysis is, of necessity, a rather simplistic representation of what can be a complex system. The analysis also errs on the side of optimism of what may be possible in practice so that the estimates are more likely to be an over estimate of potential equipment savings than an under estimate.

The Brisbane terminals use either straddle carriers, reach-stackers or fork-lifts to service trucks. The Bureau was told that a truck could be serviced in five minutes once the driver of the equipment was informed of the container and its location. Using this information and the distribution shown in figure V.3 it is easily shown that five straddle carriers, reach-stackers or fork-lifts would be required to service the trucks. If the flow of trucks were uniform this number would reduce to three. Information provided to the Bureau indicates that the annual operating cost of straddle carriers, including depreciation and labour, is around $320 000 per annum. This works out at $5.13 per TEU of potential savings if truck arrivals at the Brisbane terminals were uniform.

The Bureau was supplied with the hourly distribution of trucks serviced at one of the Botany Bay terminals. The distribution was derived from truck servicing data for the period 1 December 1991 to 14 January 1992. The distribution is shown in figure V.4.

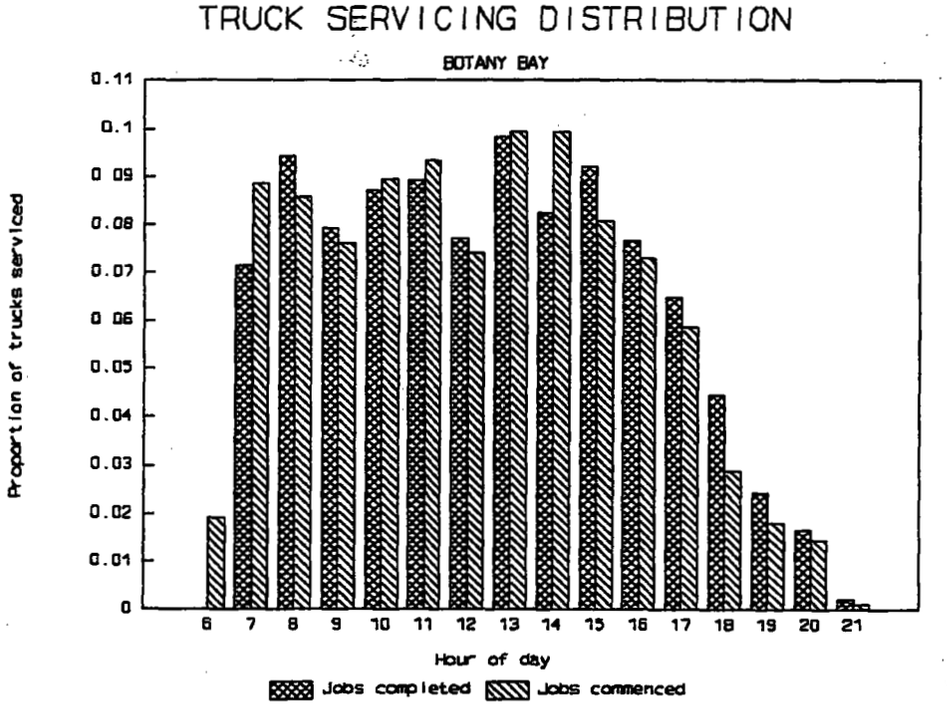


Figure V.4 Distribution of truck servicing (Botany Bay)

Source Data supplied by terminal operators

The distribution for truck servicing is reasonably uniform during the day shift at this terminal. Therefore, the greatest opportunity for smoothing the flow of containers is to increase the volume of containers processed during the evening shift. This then reduces the number of containers handled per hour during the day shift and therefore the quantity of equipment required.

The Botany Bay terminals mostly use transtainers to service trucks, although fork-lifts are also used. Transtainers typically can handle 20 containers per hour when servicing trucks and fork-lifts can process trucks at approximately half this rate. This choice of equipment means that, unlike Brisbane and other ports, the trucks move to the stacks to deliver or pick up containers.

For this particular terminal it was estimated that three fork-lifts could be saved. This is equivalent to $5.76 per TEU.

For the other Botany Bay terminal it was assumed that the proportion of containers handled in the evening shift was the same as for the other Botany Bay terminal (ie 23 per cent of jobs commenced and 19 per cent of jobs completed). The distribution of trucks serviced during the day shift was assumed to be similar to that shown in figure V.4, except that the peak of the distribution was increased to reflect the usual quantity of equipment allocated to road work.

As for the first Botany Bay terminal analysed, the equipment required for the current distribution was compared with the quantity of equipment required if an equal number of trucks were serviced for each hour of the day and evening shifts. Using these assumptions, it was estimated that four transtainers could be saved which is equivalent to $7.14 per TEU.

The weighted average of the estimates for the two Botany Bay terminals is $6.66 per TEU. It was assumed that this weighted average saving also applied to Melbourne and that the savings estimated for Brisbane also applied to Adelaide and Fremantle. The aggregate savings in 1990–91 was then estimated to have been potentially around $7.8 million or approximately $6.27 per TEU.

EFFECT ON TRUCK QUEUES

The Bureau previously estimated that truck queuing costs were $53 million in 1988 (BTCE 1990). Recent reports suggest that, in December 1991 and January 1992, truck queues have been negligible. This is attributable to the effect of EBAs on productivity and equipment availability, the effect of reduced trade volumes and the establishment of truck booking systems by some terminal operators.

Truck booking systems have also served to smooth the flow of trucks through terminals. The analysis in this paper has focused on conditions during 1991. As truck queues costs are presently small, no savings from reduced queuing costs have been estimated. As trade picks up with economic recovery, the pressure on the road work of terminals will increase. The establishment of truck booking systems will, under these circumstances, play a much more important role in

smoothing truck processing at terminals. In the absence of booking systems truck queuing could again become a problem. The savings estimated in this paper therefore understate the savings from a smoothing of the flow of trucks through a terminal during periods of normal trade levels. In any case it is difficult to estimate how much of the savings can be attributed to the implementation of the EBAs and how much to a smoothing of flows.

A further point is that as customers become used to booking systems and become confident in the reliability of the system, flexibility in warehouse hours could become more attractive and achievable. This could become important as the demand for time-slots for trucks during the day shift increases in response to increased trade volumes.

PATTERN OF SHIP ARRIVALS

The pattern of ship arrivals can also have an effect on the uniformity of container flows through a terminal. For example a terminal at which ships arrive on average at a rate of one per day could have three or four arrive in two days and nothing for the next two days. This will affect allocation of container cranes to ships so that ships may not always be able to be allocated the number of cranes desired. The Bureau was also told that terminal operations can be less than efficient as a result. This is because an area set aside for export containers on the expectation of a ship arriving on a particular day may be at the opposite end of the quay face if the ship cannot berth at the planned berth because of disrupted schedules. No data were available to estimate the cost of this problem. It is thought that the cost is unlikely to be high as it would be due mainly to extra travel by equipment transporting containers between the ship and the container stack. At most it would require an additional tractor-trailer combination which is estimated to represent around 40 cents per TEU. The major cost involved in an uneven pattern of ship arrivals is in the waiting time cost of ships themselves.

The Bureau analysed ship arrival patterns for ships using the Botany Bay terminals. The usual method for doing this is to estimate a distribution of inter-arrival times, that is, the distribution of the times between ship arrivals. If arrivals are random then the inter-arrival times will follow a negative exponential distribution.

Figure V.5 illustrates the inter-arrival time distribution for one of the Botany Bay terminals.

The figure also includes a negative exponential distribution with the same mean inter-arrival time as that estimated from the data. From figure V.5 it appears that the actual inter-arrival times follow the theoretical distribution quite well. A chi squared test confirmed that there was no significant difference between the two. A similar test on the distribution for the other Botany Bay terminal was not as conclusive but the actual distribution was still a reasonable approximation to random arrivals.

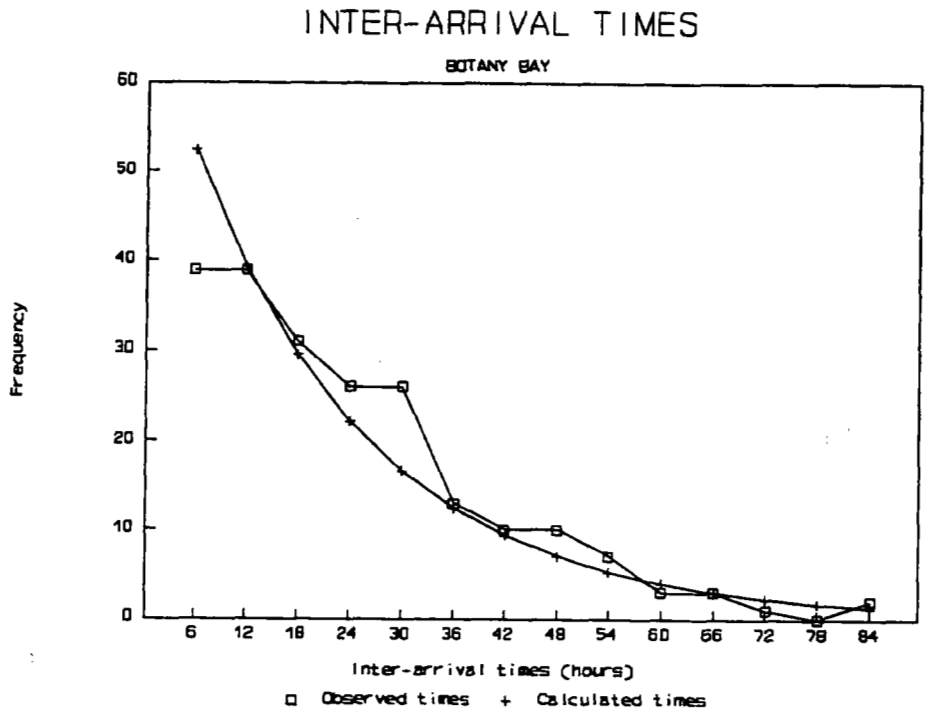


Figure V.5 Inter-arrival time distribution for Botany Bay

Source Personal communications.

Less information was available on service time distributions. Data were available for one terminal, and for this terminal an Erlang distribution with phase parameter 5 was found to be appropriate.[1]

Computer programs included in the ESCAP Regional Maritime Strategy Study (RMSS) were used to analyse the effect of reduced variance of the arrival time distributions. For this purpose, the effect of halving the variance was examined.

Berth occupancies required for this analysis were obtained from the September Quarter report of WIRA. Occupancies for the last two months reported were averaged for analysis purposes, while containers per ship were average figures derived from information published in the WIRA report for cellular container ships. The cost of ship time per day was assumed to be $24 000 ($1000 per hour).

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1. The phase parameter is the inverse of the square of the coefficient of variation. A phase parameter of 1 is equivalent to a random distribution. The variance of the distribution decreases as the value of the phase parameter increases.

On the basis of these assumptions, halving the variance would result in the reduction of ship waiting time of around 50 per cent. The berth occupancies published by WIRA for the period mentioned above, suggested that waiting times should be negligible in Adelaide and Fremantle. Waiting time reductions estimated by the RMSS models varied from 0.3 hours for Melbourne to 1.82 hours for Sydney. This translated into savings per TEU of 80 cents for Melbourne, $3.30 for Sydney and $4.10 for Brisbane. The Brisbane savings per TEU were higher than those for Sydney even though the delay savings were less because fewer TEUs are exchanged per ship call in Brisbane.

If these savings could have been achieved in 1990–91 the aggregate savings would have totalled around $2.5 million for cellular container ships berthing at container terminals.

CHAPTER 6 CONCLUSIONS

The period analysed was marked by recession. Prices, and especially stevedoring prices, have been subjected to downward pressure as a result. For this reason, the reduction in prices estimated in this paper was probably larger than would have occurred if trading conditions had been normal in 1991. Nevertheless, the major reductions in prices were in those sectors of the industry subject to micro-economic reform initiatives.

Reduced trade volumes were also reflected in fewer trucks processed by container terminals and a general absence of truck queues in the latter half of 1991. Improved terminal productivity has also contributed to the lower incidence of queuing. As trade volumes increase, the possibility of truck queues will also increase unless measures to reduce them, such as time-slotting, are implemented. Terminal operators appear to be giving considerable attention to the management of truck processing.

A further issue has been the increased capacity created by the implementation of the EBAs. This has immediately improved the terminals' ability to handle peaks in container flows. Moreover, at some future time when container handling equipment becomes due for replacement, a smoother flow of containers would reduce the amount of replacement equipment required. This is especially so for servicing trucks.

SHORE BASED SHIPPING COSTS

The analysis has shown that shore based shipping costs estimated have declined in real terms by 13 to 22 per cent for FCL containers and by 14 to 18 per cent for LCL containers, compared with those estimated for 1984–85. Overall, for containers moving through mainland capital city container terminals this represents a reduction, in real terms, of $214 million or 17 per cent. These savings will accrue initially to terminal and ship operators, and ultimately to importers and exporters.

UNEVEN FLOW OF CONTAINERS

The total potential savings of establishing an even flow of containers, were estimated to have been $10.3 million ($7.8 million from truck management plus

$2.5 million from reduced variance in ship arrival time distributions) during 1991. These savings are small compared with total shore based shipping costs. These potential savings would at first accrue to terminal operators (terminal equipment savings) and ship operators (ship delay savings). Ultimately it could be expected that both groups would pass the savings on to their customers. Eventually importers and exporters would benefit.

The ship delay time savings require some qualification. There is probably little that can be done about the arrival patterns of ships at container terminals. This means that the savings from this source may not be realisable. In any case, the generally small value of the time savings estimated may not be of use to a ship operator and therefore, if achieved, may not be translated into reduced freight rates as suggested above.

As truck queues have been reported as being negligible during the latter part of 1991, no estimate was made of potential truck queue cost savings as a result of a smoother flow of trucks through terminals. Truck queue costs can be substantial. The Bureau previously estimated that in 1988 the costs of truck queues borne by importers and exporters totalled $53 million.

REFERENCES

Abbreviations

AGPS	Australian Government Publishing Service
BTCE	Bureau of Transport and Communications Economics
BTE	Bureau of Transport Economics
PMA	Port of Melbourne Authority
PSA	Prices Surveillance Authority
WIRA	Waterfront Industry Reform Authority

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ABBREVIATIONS

ABS	Australian Bureau of Statistics
BTE	Bureau of Transport Economics
c.i.f.	Cost, insurance and freight (included in the price quoted)
EBA	Enterprise Based Agreement
f.o.b.	Free on board
FCL	Full container load
GRT	Gross registered tonne
HORSCOTCI	House of Representatives Standing Committee on Transport, Communications and Infrastructure
LCL	Less than container load
MSB	Maritime Services Board
PMA	Port Melbourne Authority
PSA	Prices Surveillance Authority
RMSS	Regional Maritime Strategy Study
SACCS	Shipping and Air Cargo Commodity Statistics
TEU	Twenty-foot equivalent unit
WIRA	Waterfront Industry Reform Authority